

Project X: Status, Strategy, Meeting Goals

An aerial photograph of a large, flat field with a river on the right side. In the background, there are several buildings, including a prominent white, curved structure. The sky is clear and blue.

Steve Holmes
Project X Collaboration Meeting
October 25, 2011



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- Project Goals
 - Update on Activities of the Six Months
 - Programmatic/political
 - Technical
 - Project X Strategy
 - DOE Workshop
 - Collaboration Activities
 - FY12 Budget
 - Meeting Goals, Agenda, and Organization

Our websites:

<http://projectx.fnal.gov>

<http://projectx-docdb.fnal.gov>

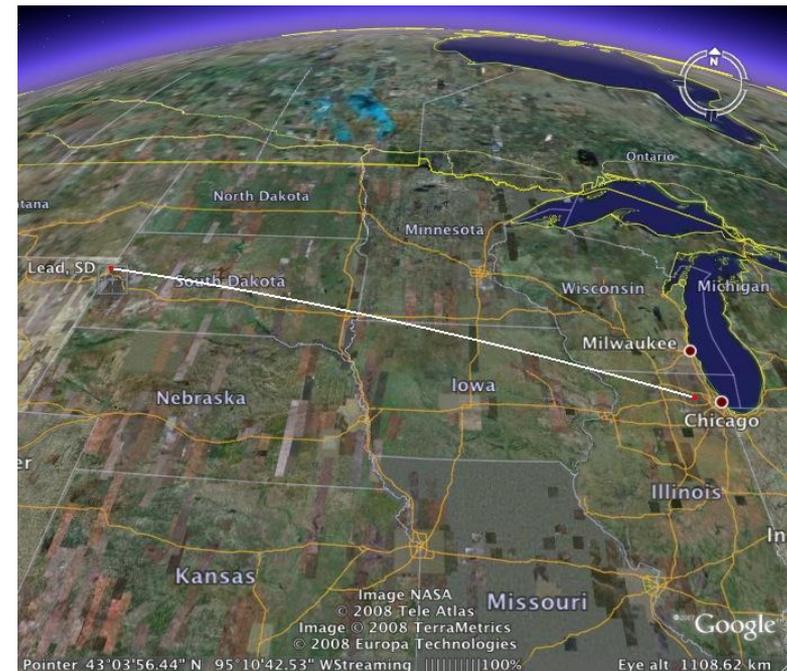
Meeting website:

http://projectx.fnal.gov/meetings/2011/october_11_collaboration_meeting.html

Project Goals: Mission Elements



- A neutrino beam for long baseline neutrino oscillation experiments
 - 2 MW proton source at 60-120 GeV
- High intensity, low energy protons for kaon and muon based precision experiments
 - Operations simultaneous with the neutrino program
- A path toward a muon source for possible future Neutrino Factory and/or a Muon Collider
 - Requires ~4 MW at ~5-15 GeV
- Possible missions beyond P5
 - Standard Model Tests with nuclei and energy applications





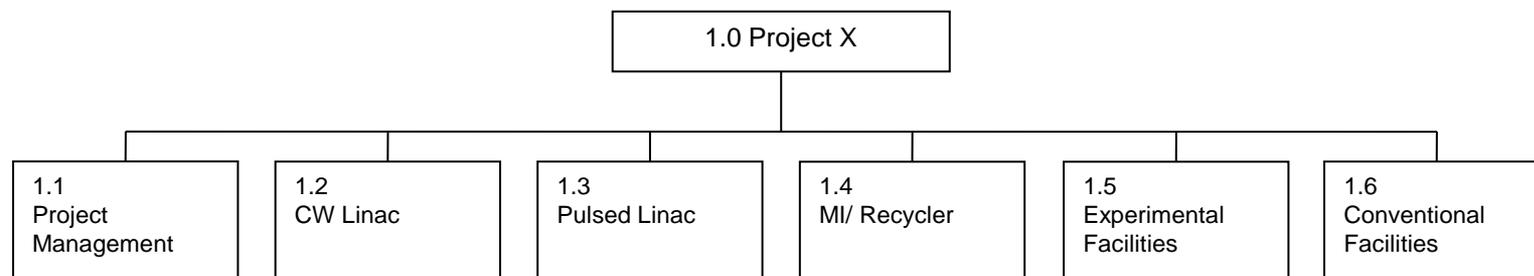
- DOE/OHEP briefing, May
 - CD-0 Plan/Timeline
 - Mission Needs Statement
 - Physics Program/Workshop Preparations
 - Staging Options
 - Cost Range
 - Collaboration
 - India Collaboration
- India Collaboration
 - DOE – DAE Implementing Agreement on “Accelerator and Particle Detector Research & Development for Discovery Science” – signed in July
 - Fermilab, SLAC, JLab, Cornell listed as U.S. participating institutions
 - Specific MOUs will be written underneath this agreement
 - Supplements to IIFC covering rf, cryo, instrumentation implemented
 - Preliminary discussions with India on construction/commissioning phase



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- DOE Intensity Frontier Workshop announced
 - Dates: November 30 – December 2, Rockville, MD
 - More details below
 - Joint LBNE/PX strategy announced by Fermilab Director following Fermilab Institutional Review, June
 - More details below
 - DUSEL Task Force
 - Report to HEPAP, June
 - Project X Lunch Forum, DPF Meeting, August
 - <http://indico.cern.ch/conferenceTimeTable.py?confId=129980#20110810>
 - Jim Siegrist new Director for High Energy Physics/Office of Science
 - Project X briefing at Fermilab, September 28
 - Bob Tschirhart appointed Project X Project Scientist for Experimental Programs, October
 - Sergei Nagaitsev and Jim Kerby formalized as Project Scientist for Accelerator Facilities and Project Engineer respectively
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- Technical Board established with cross-collaboration membership
 - Advisory to the Project Scientist for Accelerator Facilities
 - Current representation includes Fermilab, JLab, SLAC, ANL, LBNL, India
 - Decision on HWR vs SSR0
 - FY2012 appropriations bills reported out of committee in House and Senate
 - Senate bill asks OHEP for an Intensity Frontier strategy by June (180 days from bill enactment) specifically addressing:
 - “expected benefits of intensity frontier science”
 - “a strategy for maintaining the U.S. lead”
 - “funding needs over the next ten years, including construction activities”
 - DOE Workshop is a key element
 - Project X FY2012 budget established at \$13.0M
 - FY2011 = \$10.5M



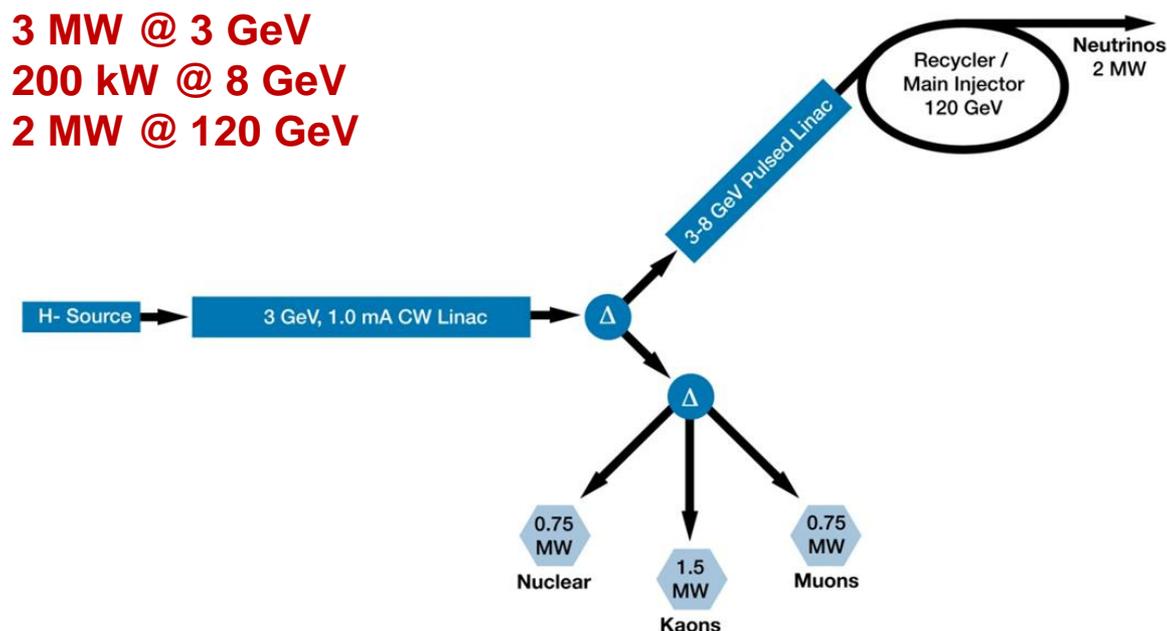
- **Level 2 Structure/Appointments**

- CW Linac R. Kephart, V. Lebedev
- Pulsed Linac N. Solyak
- Main Injector/Recycler I. Kourbanis
- Experimental Facilities R. Tschirhart

- **Project Office: S. Holmes, S. Nagaitsev, R. Tschirhart, J. Kerby, S. Mishra, E. Peoples, M. Smith**



- Reference Design continues as our baseline concept
 - Modified configuration of initial 10 MeV acceleration (RFQ and HWR)
 - Functional Requirements Specification (FRS) updated to reflect changes





- Task Forces established to look at future connections
 - Muon Collider Task Force – K. Gollwitzer
 - Jointly sponsored by PX and MAP
 - Muons @ PX Task Force – E. Prebys, V. Lebedev
- Front End Test Facility (PXIE) in planning stage
 - Prototype of the first ~15-30 MeV of Project X.
 - Validate the concept for the Project X front end, thereby eliminating the primary technical risk element within the Reference Design.
 - Wideband chopper; low- β acceleration
 - Operate at full design parameters
 - Integrated systems test goals:
 - 1 mA average current with 80% chopping of beam delivered from RFQ
 - Efficient acceleration with minimal emittance dilution through ~15 MeV
 - Potential utilization in Project X facility following successful demonstration
 - Developed/operated by Project X Collaboration

White paper available: <http://projectx.fnal.gov/research-and-development.shtml>



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- The Director has established a strategy of pursuing LBNE, while in parallel establishing the technical basis and developing an international partnership ready to construct PX as soon as the opportunity arises.

⇒ **PX planning needs to accommodate possibility of a > FY16 construction start**

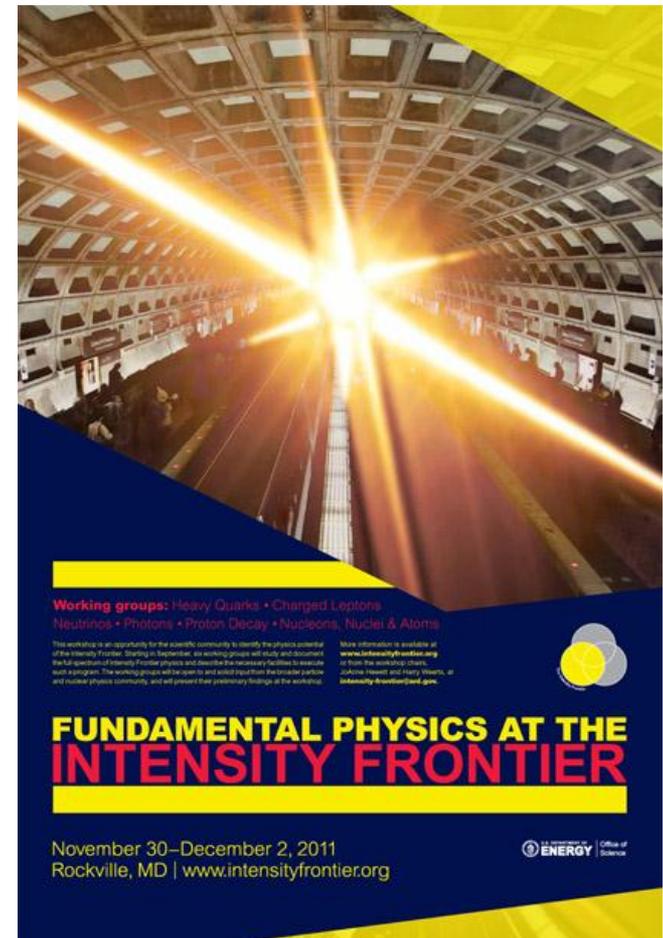
- Goal: Be ready to proceed when the opportunity comes
 - Receive CD-0 plus a nominal start date from DOE in 2012
 - Framework for planning and sustaining potential partners
 - Continue to optimize facility design for performance/cost; staging options
 - Focus technology development on items critical to validating performance/cost goals
 - Complete R&D in 2015-2016 timeframe
 - Maintain near-final drafts of all critical documents
 - Engage community in designing the PX physics program
 - DOE on the Intensity Frontier Workshop
 - Project Scientist for Experimental Programs
 - Provide a focal point to keep people meaningfully engaged ⇒ PXIE

Should be achievable with annual PX budget at ~\$15M + flat funding in GAD/SRF/ILC + \$5M/year for experimental program development

DOE Intensity Frontier Workshop



- Dates: November 30 – December 2, Rockville, MD
 - Not a Project X workshop although expect PX to be very significant presence
 - Focus on opportunities for U.S. leadership: both particle and nuclear physics research
 - Engagement with Energy and Cosmic Frontier proponents
 - Co-chairs: JoAnne Hewett/SLAC, Harry Weerts/ANL,
 - Proton performance parameters for the next two decades at Fermilab provided to the chairs





- Two MOUs covering the RD&D Phase

National

ANL
BNL
Cornell
Fermilab
LBNL

ORNL/SNS
MSU
TJNAF
SLAC
ILC/ART

IIFC

BARC/Mumbai
IUAC/Delhi
RRCAT/Indore
VECC/Kolkata

- Informal collaboration/contacts with CERN/SPL, ESS
China/ADS, Korea/KoRIA

- **Collaboration Council**

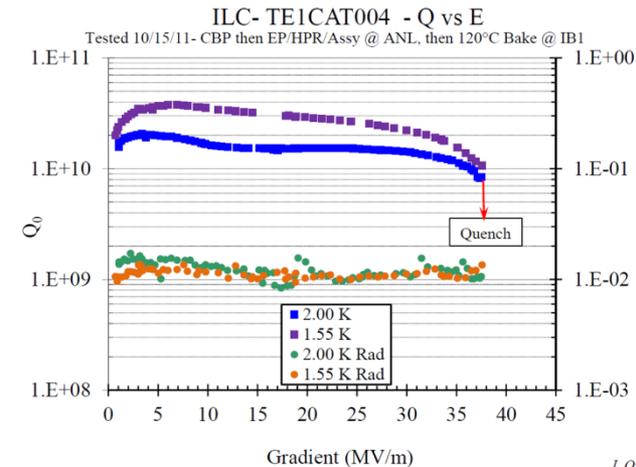
- Institutional representation from all collaborators
- Semi-annual meeting

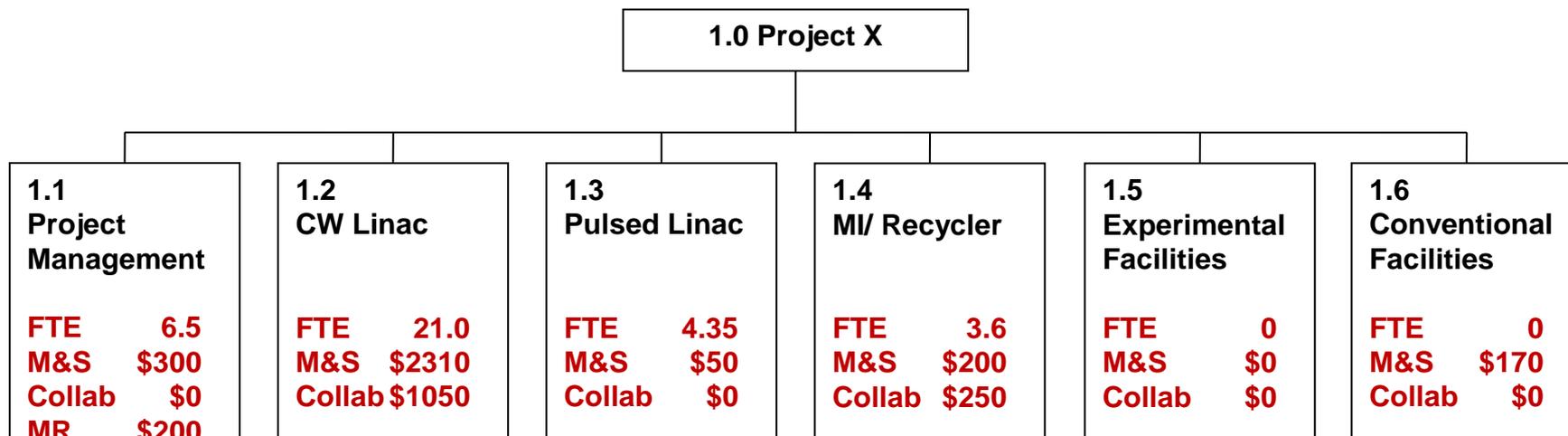
- **Weekly Friday meeting:** <https://indico.fnal.gov/categoryDisplay.py?categId=168>

- Collaborator participation via webex
- Meeting notes posted

- **Semi-annual Collaboration meetings**

- Fall at Fermilab, spring elsewhere





Note: Dollar amounts are direct

Note: Does not include significant activities supported under SRF and GAD

- New WBS consistent with what we will use as a project
- A complete new set of task codes, aligned with this WBS became operational on October 1, 2011

Collaboration Meeting: Goals



- Detailed discussion of the Reference Design, including specifically targeted technical issues and questions
- Establish the scope of work and institutional responsibilities for FY12
- Establish input to DOE Workshop
- Establish the plan for a front end test facility at Fermilab
 - Facility goals and scope
 - Collaborator participation
 - Plan for accomplishment of the work
- Collaboration Council Meeting
 - Project Status/Strategy
 - Collaboration governance plan
 - Institutional assignments
 - Budget outlook
 - Site for spring meeting

Collaboration Meeting Agenda



- Tuesday, October 25
 - Opening plenary session 08:30-12:00
 - Welcome, Fermilab Strategic Plan P. Oddone
 - Project X News, Strategy, Meeting Goals S. Holmes
 - Project X Reference Design and R&D Plan S. Nagaitsev
 - Coffee Break 10:00-10:30
 - ESS Activities D. McGinnis
 - SPL Activities E. Ciapola
 - Indian Activities P. Singh
 - Lunch (self-serve) 12:00-13:00
 - Afternoon plenary session 13:00-14:30
 - DOE Intensity Frontier Workshop J. Hewett, H. Weerts
 - Muons@PX Task Force V. Lebedev
 - Muon Collider Task Force K. Gollwitzer
 - Coffee Break 14:30-15:00
 - Working Groups one 15:00-17:30
 - Adjourn 17:30
 - Collaboration Council 18:00-19:00

<https://indico.fnal.gov/conferenceTimeTable.py?confId=4828#all>

Collaboration Meeting

Agenda



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- **Wednesday, October 26**
 - Working Group session two 08:30-10:00
 - Coffee Break 10:00-10:30
 - Working Group session three 10:30-12:00
 - Lunch 12:00-13:00
 - Working Group session four 13:00-15:00
 - Coffee Break 15:00-15:30
 - Working Group session five 15:30-17:30
 - Adjourn 17:30

Collaboration Meeting Agenda



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- Thursday, October 27
 - Working Group Reports 08:30-10:00
 - WG1: CW Linac + PXIE TBD
 - WG2: Pulsed Linac TBD
 - WG3: MI/Recycler TBD
 - Coffee Break 10:00-10:30
 - Working Group Reports 10:30-11:00
 - WG4: Exper. Program/Requirements TBD
 - Adjourn 11:00

Collaboration Meeting

Working Groups



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- Charge to the working groups:
 - Detailed discussion of Reference Design, including specifically targeted technical issues and questions;
 - Confirm goals and work assignments for FY2012;
 - Develop strategies for the front end test facility (PXIE);
 - Identify any issues related to the above that need resolution;



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- WG1: CW Linac & PXIE 1 West
 - WG2: Pulsed Linac 1 North
 - WG3: MI/Recycler 1 North
 - WG4: Experimental Programs Snakepit/1 North

⇒ With a few exceptions we are limiting ourselves to two working groups running in parallel. See meeting website for details:

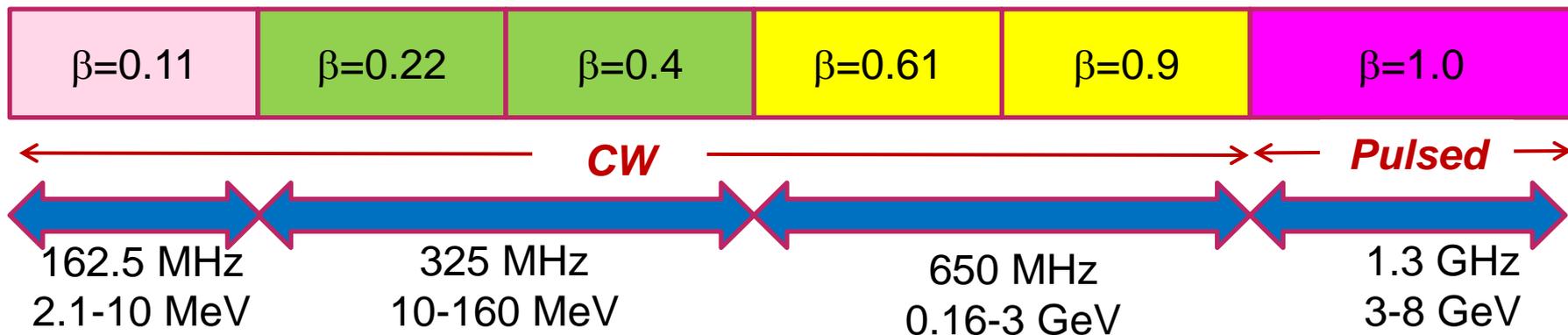
<https://indico.fnal.gov/conferenceTimeTable.py?confId=4828#all>



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- Project X Reference Design concept has remained stable for 18 months, subject to technical adjustments
 - Adopt 162.5 MHz front end through 10 MeV
 - R&D program underway with very significant investment in srf
 - PXIE identified as centerpiece of the program – planning underway
 - Significant progress in other areas:
 - See Sergei's talk
 - Joint LBNE/PX strategy adopted by Fermilab
 - “Move forward and be ready”
 - Planning based on ~FY2016-2020 construction period
 - DOE sponsored Intensity Frontier Physics Workshop this fall
 - Emphasis on research opportunities, leadership
 - Necessary for moving PX forward
 - Collaboration Meeting Goals:
 - Look at RDR, in particular discuss areas of technical uncertainty
 - Formulate the plan for next year
 - Formulate plan for PXIE
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SRF Linac Technology Map



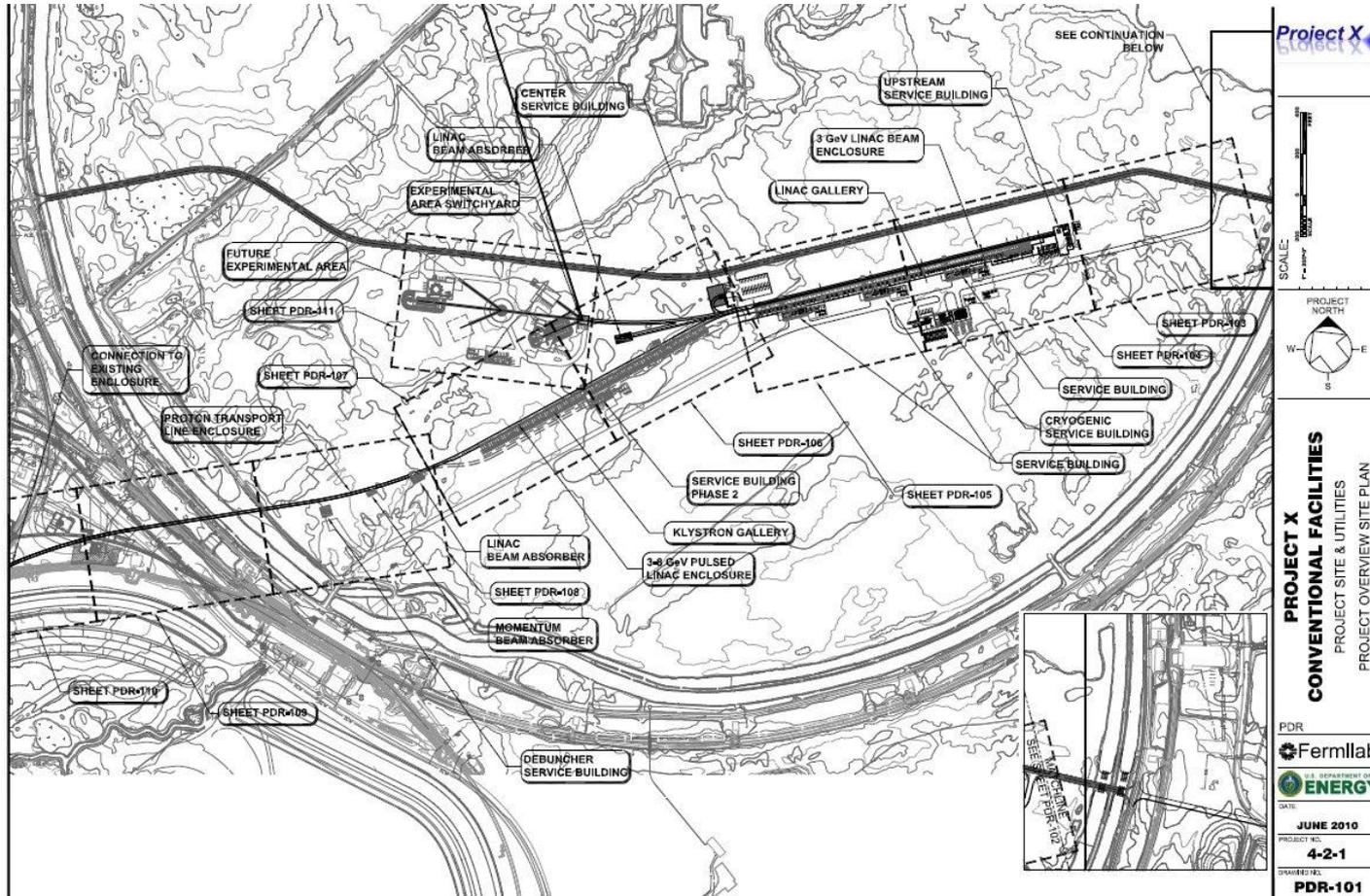
Section	Freq	Energy (MeV)	Cav/mag/CM	Type
HWR ($\beta_G=0.11$)	162.5	2.1-10	9/6/1	HWR, solenoid
SSR1 ($\beta_G=0.22$)	325	10-42	20/20/ 2	SSR, solenoid
SSR2 ($\beta_G=0.4$)	325	42-160	40/20/4	SSR, solenoid
LB 650 ($\beta_G=0.61$)	650	160-460	36 /24/6	5-cell elliptical, doublet
HB 650 ($\beta_G=0.9$)	650	460-3000	160/40/20	5-cell elliptical, doublet
ILC 1.3 ($\beta_G=1.0$)	1300	3000-8000	224 /28 /28	9-cell elliptical, quad

Configuration Evolution

Physics Requirements



	Proton Energy (kinetic)	Beam Power	Beam Timing
Rare Muon decays	2-3 GeV	>500 kW	1 kHz – 160 MHz
(g-2) measurement	8 GeV	20-50 kW	30- 100 Hz.
Rare Kaon decays	2.6 – 4 GeV	>500 kW	20 – 160 MHz. (<50 psec pings)
Precision K^0 studies	2.6 – 3 GeV	> 100 mA (internal target)	20 – 160 MHz. (<50 psec pings)
Neutron and exotic nuclei EDMs	1.5-2.5 GeV	>500 kW	> 100 Hz





- The primary elements of the R&D program include:
 - Development of a wide-band chopper
 - Capable of removing bunches in arbitrary patterns at a 162.5 MHz bunch rate
 - Development of an H- injection system
 - Require between 4.4 – 26 msec injection period, depending on pulsed linac operating scenario
 - Superconducting rf development
 - Includes six different cavity types at three different frequencies
 - Emphasis is on Q_0 , rather than high gradient
 - Typically $1.5E10$, 15 MV/m (CW)
 - $1.0E10$, 25 MV/m (pulsed)
 - Includes appropriate rf sources
 - Includes development of partners
- Goal is to complete R&D phase by 2015